

Claims:

1. A PVD process for coating substrates, wherein the substrate is pre-treated in the vapour of a pulsed, magnetic field-assisted cathode sputtering operation, and during pre-treatment a magnetic field arrangement of the magnetron cathode type, with a strength of the horizontal component in front of the target of 100 to 1500 Gauss, is used for magnetic field-assistance, and wherein after pre-treatment further coating is effected by means of cathode sputtering, with the power density of the pulsed discharge during pre-treatment being greater than 1000 W.cm⁻².

2. A process in accordance with Claim 1 wherein the power density falls within the range from 2000 to 3000 W.cm⁻².

3. A process in accordance with Claim 1 wherein the pulse duration (on-time) ranges between 10 and 1000 µs, and that the pulse interval (repetition period) is between 0.2 ms and 1000 s.

4. A process in accordance with Claim 1 wherein the pulse duration is 50 µs and the pulse interval is 20 ms.

5. A process in accordance with Claim 1 wherein the discharge, which is of the magnetron discharge type, is distributed over the cathode surface area and occupies at least 50 % of the surface area.

6. A process in accordance with Claim 5 wherein the discharge is distributed over 70-90 % of the cathode surface area.

7. A process in accordance with Claim 1 wherein the average pulsed discharge current density is less than 10 A.cm⁻².

8. A process in accordance with Claim 1 wherein the localised maximum pulsed discharge current density is less than 100 A.cm^{-2} .

5 9. A process in accordance with Claim 1 wherein the pulses generated have a peak voltage from 0.5 to 2.5 kV.

10 10. A process in accordance with Claim 1 wherein pre-treatment with magnetic field-assisted cathode sputtering is conducted in a non-reactive atmosphere, e.g. in Ne, Ar, Kr or Xe, with targets made of Cr, V, Ti, Zr, Mo, W, Nb or Ta.

11. A process in accordance with Claim 1 wherein pre-treatment is effected with Ar in the pressure range from 10^{-5} to 10^{-1} mbar.

15 12. A process in accordance with Claim 1 wherein pre-treatment is effected with Ar at a pressure of 10^{-3} mbar.

20 13. A process in accordance with Claim 1 wherein during pre-treatment a negative bias voltage within the range from 0.5 to 1.5 kV is applied to the substrates, so that an etching or cleaning process is initiated simultaneously with an ion implantation process (ABS technique).

25 14. A process in accordance with Claim 13 wherein the negative bias voltage is pulsed with pulse widths of $2 \mu\text{s}$ to 20 ms and a pulse interval which is likewise $2 \mu\text{s}$ to 20 ms.

30 15. A process in accordance with Claim 1 wherein the coating formed by cathode sputtering consists of the nitrides TiN, ZrN, TiAlN, TiZrN, TiWN, TiNbN, TiTaN, TiBN or the carbonitrides TiCN, ZrCN, TiAlCN, TiZrCN, TiVCN, TiNbCN, TiTaCN or TiBCN.

16. A process in accordance with Claim 15 wherein the coating contains 0.1 to 5 atomic % of the rare earth elements Sc, Y, La or Ce.

5 17. A process in accordance with Claim 1 wherein the coatings consist of fine (nanometre-scale) multi-layer coatings with a periodicity of 1 to 10 nm, from the group comprising TiN/TiAlN, TiN/VN, TiN/NbN, TiN/TaN, TiN/ZrN, TiAlN/CrN, TiAlN/ZrN, TiAlN/VN, CrN/NbN, CrN/TaN, CrN/TiN, Cr/C, Ti/C, Zr/C, V/C, Nb/C or Ta/C.

10 18. A process in accordance with Claim 16 wherein one of the cited individual layers contains 0.1 to 5 atomic % of the rare earth elements Sc, Y, La or Ce.

15 19. A process in accordance with Claim 16 wherein both of the cited individual layers contain 0.1 to 5 atomic % of the rare earth elements Sc, Y, La or Ce.

20 20. A process in accordance with Claim 1 wherein the cathode sputtering employed during coating is of the unbalanced magnetron type.

25 21. A process in accordance with Claim 1 wherein identical cathodes and identical magnetic field arrangements are used for pre-treatment and coating.

22. A process in accordance with Claim 21 wherein specific adaptations of the magnetic field strength are made, by adjusting the distance of the magnet array from the target surface, in order to optimise the pre-treatment and coating operations.